LAKE COUNTY, ILLINOIS

2013 TOWER LAKE SUMMARY REPORT

PREPARED BY THE

LAKE COUNTY HEALTH DEPARTMENT

Population Health Environmental Services

Outlet of Tower Lake 2013

Tower Lake is an 69.2 acre impoundment that was constructed in 1915. It was enlarged in the 1940's to its current size, by dredging of the southeastern bay . Water leaving Tower Lake eventually flows into the Fox River via the Tower Lake Drain. The lake is available for use by residents for fishing, swimming, and aesthetics. Gas powered motors are not allowed.

In 2013, Tower Lake was monitored for water quality by the LCHD-ES. A Multiparameter sonde was used to measure water clarity, temperature, pH, dissolved oxygen, and conductivity. Additionally water samples were collected using a Van Dorn sampler and tested for alkalinity, phosphorus, nitrogen, solids, and chloride. Assessments were made of aquatic vegetation, shoreline erosion, land use and the watershed.

The overall water quality of Tower Lake is poor. Like many of the lakes in our county, it is impaired for phosphorus, based upon the Illinois Environmental Protection Agency's (IEPA) total phosphorus standard of ≥ 0.05 mg/L. The total phosphorus (TP) concentrations in Tower Lake ranged from 0.040 mg/L to 0.122 mg/L. The 2013 average TP concentration was 0.083 mg/L, and has declined since 2007 when the average TP con-

ENVIRONMENTAL SERVICES WATER QUALITY SPECIALISTS

Kathy Paap	Kelly Deem	Gerard Urbanozo
kpaap@lakecountyil.gov	kdeem@lakecountyil.gov	gurbanozo@lakecountyil.gov

SPECIAL POINTS OF INTEREST:

- *Phosphorus Impairment*
- *Shoreline Erosion*
- *Algal Blooms*

INSIDE THIS ISSUE:

SUMMARY (CONTINUED)

centration was 0.066 mg/L. It also exceeds the median TP concentration of 0.067 mg/L for lakes in the county monitored for TP between 2000 and 2013.

Lake Facts:

Major Watershed: Fox River

Sub-Watershed: Tower Lake Drain

Location: T43N, R9E, Section 2

Surface Area: 69.2 acres

Shoreline Length: 3.22 miles

Maximum Depth: 7.5 feet

Average Depth: 4.5 feet

Lake Volume: 234.3 acre-feet

Watershed Area: 2,790.57 acres

Lake Type: Impoundment

Management Entities: Tower Lake Improvement Association

Current Uses: fishing, swimming, non-motorized boating, aesthetics

Access: Private

Phosphorus and nitrogen are normally limiting nutrients in our region. The ratio of total nitrogen to total phosphorus (TN:TP) in 2013 was 20:1. This ratio indicates both nutrients were plentiful enough to cause algal blooms or excessive plant growth. A closer investigation of monthly TN:TP reveals that from May through June the lake was limited by phosphorus with TN:TP ratios exceeding 20:1. In July, there were plenty of both nutrients available (TN:TP of 12:1) to support nuisance plant and algal growth, before once again becoming limited by phosphorus for the remainder of the season, August through September.

Total Kjeldahl nitrogen, (TKN) ranged from 1.06 mg/L in May to 2.57 mg/L in September. TKN is the organic form of nitrogen and is usually tied up in plant and algal cells and therefore is biologically unavailable. The biologically available nitrogen (nitrate, nitrite and ammonium) in the water was non-detectable for the entire season. Any nitrogen that became available was taken up immediately by organisms.

Carlson's Trophic State Index (TSIp) uses average TP to estimate the trophic state of a lake. The TSIp for Tower Lake was 68 and therefore is considered an eutrophic or nutrient rich lake. Tower Lake ranked 94th out of 175 lakes in the county measured for phosphorus between 2000 and 2013.

There are many potential sources of phosphorus available to Tower Lake. Internal cycling of phosphorus occurs when DO concentrations become low(≤2.0 mg/L), in the water near the lake bottom allowing for the release of phosphorus from anoxic (dissolved oxygen ≤1 mg/L) bottom sediments. Eroding shorelines can additionally introduce phosphorus rich sediments into the water column. Activities taking place in the watershed such as turf fertilization and abundant goose populations can affect TP concentrations. Reminding residents within the Tower Lake watershed to use phosphorus free fertilizers and to keep yard waste out of the water, may all go a long way in reducing phosphorus inputs into Tower Lake. Additionally, death of plants and algae are also a source of both phosphorus and nitrogen.

Algal blooms were prevalent especially during late summer. In July, the Tower Lakes Improvement Association (TLIA) made the decision to close the swim beach for a couple of days due to the presence of a potentially harmful algal bloom (HAB) which colonized the entire lake. The sample collected on Tower Lake was tested by the LCHD-ES and indicated the presence of microcystin, a common toxin produced by blue-green algae, and so samples were sent out to an independent laboratory for further analysis. Swim bans usually occur due to elevated E-coli bacteria (235 colonies/100 mL) being present in a water sample collected at the beach. Tower Lake experiences swim bans with some regularity. There were two swim bans due to elevated E-coli during 2013. Since 2007, seven other bans have occurred, 4 of them in 2010, 1 in 2009 and 2 in 2008. It was noted that gulls were using the swim platform on at least one occasion; and there were feces from waterfowl on the platform at other times during the season.

The 2013 average chloride concentration was 117 mg/L, which is a decrease of 46% from the average chloride concentration measured in 2007. Both concentrations were below the critical concentration defined by the U.S. Environmental Protection Agency for general use of 230 mg/L. However, many lakes in the county have exhibited increasing chloride concentrations over the years, and some have even exceeded the standard. The main contributing factor has been linked to deicing products, in particular the use of rock salt. Water softener system discharges have also been identified as another source of chlorides into waters. It only requires 1

SUMMARY (CONTINUED)

teaspoon of salt to pollute 5 gallons to the USEPA critical value. The lake ecosystem can be impacted if concentrations remain at the critical level 230 mg/L for extended periods of time.

An assessment of the aquatic vegetation in Tower Lake was conducted in July, 2013. Seventy-one points were assessed. Fifty-four percent of the points sampled were colonized by aquatic vegetation. The estimated plant density in the lake was 36.5%. Plant diversity (number of species) remained the same as it was in 2007. Five species were detected, including Chara (a macroalgae). Non-native invasive species such as Eurasian Water Milfoil and Curlyleaf Pondweed were not detected during the vegetation survey. Although the diversity remained the same, the Floristic Quality Index (FQI) increased from 11.0 in 2007 to 14.0 in 2013. This is due to more conservative species (less weedy) being present during the 2013 survey.

The shoreline of the lake was assessed for erosion in September, 2013. The amount of erosion detected along the shorelines of Tower Lake has decreased. This may be due to efforts by the TLIA to remediate eroded shorelines identified in 2007. In 2013, 44% of the shoreline exhibited some degree of erosion. Twenty-two percent of erosion detected was either moderate (16%) or severe (6%). An additional 22% of the shoreline was assessed as having slight erosion occurring upon it.

WATER CLARITY

Water clarity is measured by Secchi disk. At each visit, the Secchi disk is lowered into the water column at the deepest part of the lake, until it is no longer visible.

In 2013, the average Secchi depth in Tower Lake was 2.31 feet ; and is slightly lower than the median Secchi depth of 3.00 feet for lakes measured for Secchi depth in the county between 2000 and 2013. Water clarity in the lake decreased substantially since 2007 when the average Secchi depth was 4.31 feet, and is the same as it was back in 2001. In 2013, Tower Lake ranked 102nd out of 158 lakes in the county whose average Secchi depths have been measured since 2000.

The monthly Secchi depths increased from May to June, however, decreased gradually for the remainder of the 2013 season (Figure 1), likely due to algal blooms occurring in the lake.

Algae (filamentous and planktonic) were noted as occurring in Tower Lake throughout the entire monitoring season. Notably, at the end of July a blue-green algae bloom occurred in the lake resulting in no swimming at the beach (See section on algae).

Providing areas for aquatic plants to thrive within Tower Lake would help to improve the water clarity as plants compete with algae for nutrients and light; additionally they secure the bottom sediments and minimize sediment redistribution into the water column. This becomes important in shallow lakes such as Tower, where water clarity additionally becomes compromised by wind and wave action, re-suspending sediments.

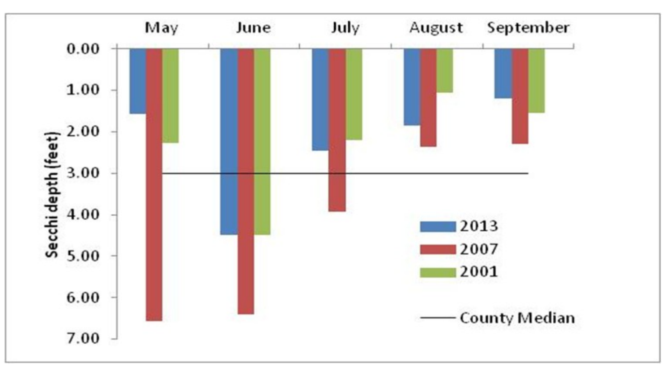


Figure 1. Water clarity in Tower Lake 2001, 2007, and 2013. (Measurements taken May —September)

TOTAL SUSPENDED SOLIDS

Total Suspended Solids (TSS) are made up of both volatile solids (TVS), which come from organic sources such as plankton and algae; and sediments or non-volatile suspended solids (NVSS). Both adversely affect water clarity.

During 2013, the average TSS concentration in Tower Lake was 9.3 mg/L. This was a 24% increase from the 2007 average TSS concentration of 7.1 mg/L; and is greater than the county median of 8.0 mg/L for lakes measured for TSS between 2000 and 2013.

Figure 2 shows the concentrations of TVS and NVSS found in Tower Lake. TVS concentrations were relatively stable ranging from 103mg/L to a high of 125 mg/L. TVS concentrations were significantly higher than NVSS concentrations in the lake (Figure 2). This is reflective of the persistent algal blooms that were observed on and in the lake throughout the entire monitoring period (May - September). In 2013, the average TVS concentration was 111 mg/L, this is slightly lower than the county median for lakes sampled since 2000 (119 mg/L).

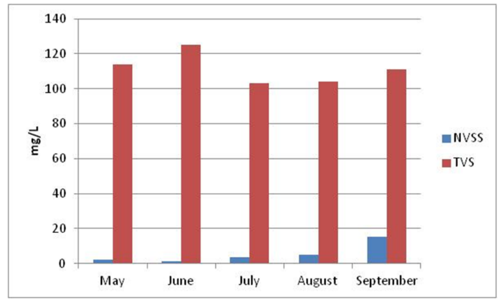


Figure 2. TVS and NVSS concentrations in Tower Lake, 2013.

NUTRIENTS

Phosphorus and nitrogen are normally limiting nutrients in natural systems. Like many lakes within Lake County, Tower Lake was impaired for total phosphorus (TP). This is due to TP concentrations of ≥0.05 mg/L occurring on at least one occasion during the monitoring year. In 2013, the average TP concentration on Tower Lake was 0.083 mg/L. This is greater than the median TP concentration of 0.067 mg/L from lakes monitored since 2000, as well as the average TP concentration recorded in 2007 of 0.066 mg/L.

Total nitrogen to total phosphorus (TN:TP) ratios determine which of the two nutrients (phosphorus or nitrogen limit the growth of plants and algae. Ratios over 20:1 indicate a system limited by phosphorus; under 10:1 the system becomes limited by nitrogen. Ratios falling between 10:1 and 20:1 indicates that the system has plenty of both nutrients to support nuisance plant and algae growth. Tower Lake is considered a phosphorus limited system with an overall TN:TP ratio of 20:1;

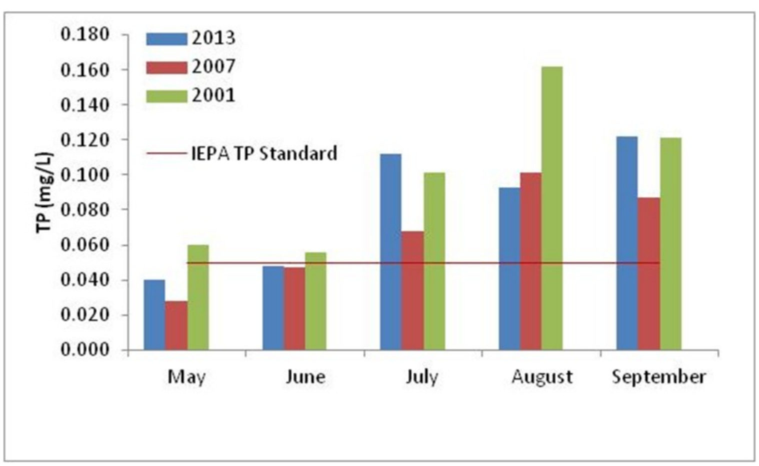


Figure 3. TP concentrations in Tower Lake 2001, 2007 and 2013.

Nutrients (continued)

therefore, any additional phosphorus into the system can produce nuisance plant or algal growth. Monthly TN:TP ratios indicated that Tower Lake was a phosphorus limited system until July when neither nutrient was limiting (TN:TP = 12:1). A blue-green algae bloom dominated the lake in late July. The TN:TP ratios in August indicated phosphorus was again the limiting nutrient.

Tower is considered an eutrophic lake based upon its Trophic State Index (TSIp) score of 68. The TSIp is based upon the total average phosphorus concentration. The higher the score the more nutrient enriched the lake is. Tower Lake ranked 94th out of 175 lakes in the county assessed for phosphorus between 2000-2013.

Phosphorus (P) can be introduced into a system either from external sources (i.e. watershed) or internally from bottom sediments and aquatic organisms. Anoxic sediments release phosphorus into the water column and can occur when waters above the sediment are still oxic at approximately 2 mg/L (Nurnberg, 2013).

Tower Lake exhibits polymictic tendencies. Polymictic lakes will destratify on more than one occasion during the season rather than only during fall turnover and is common in shallower lakes. However, because of this, the lowest hypoxia (low oxygen condition) may not always be exhibited in the water column, meanwhile anoxic sediments continue to release P into the system.

The internal cycling of phosphorus into Tower Lake may be the cause of the historical and current algal blooms plaguing the lake. LCHD-ES recommends that TLIA encourage residents in the watershed to utilize best practices for reducing phosphorus inputs, such as minimizing goose populations, using phosphorus free fertilizers and keeping yard waste out of the lake (Figure 4).

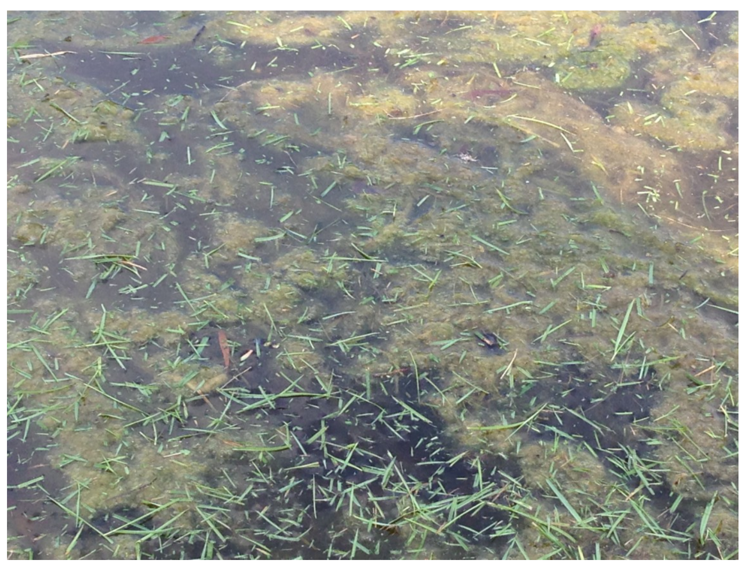


Figure 4. Grass clippings intermixed with filamentous algae on Tower Lake, 2013. This practice should be discouraged on the lake.

WATERSHED

The watershed of Tower Lake is quite large, estimated to be 2,790.57 acres. Land use in the watershed is comprised of 10 categories (Appendix A, Table 1). The dominant land uses were Single Family (46.7%), and Wetlands (12.5%) (Figure 5). The percent total estimated runoff is dominated by Single Family (53.9%) and Transportation (37.0%). Due to it's expansive watershed, Tower Lake is impacted by the large ratio of watershed to lake volume (100:1); and subsequently a pretty short retention time, approximately 42.86 days. Therefore it is important for residents in the watershed to maintain their properties so that they cause as little impact as possible to Tower Lake; practices such as those discussed under the nutrients section and applying deicers sensibly are just a few practices that will go a long way to alleviate some of the water quality problems discussed in this report.

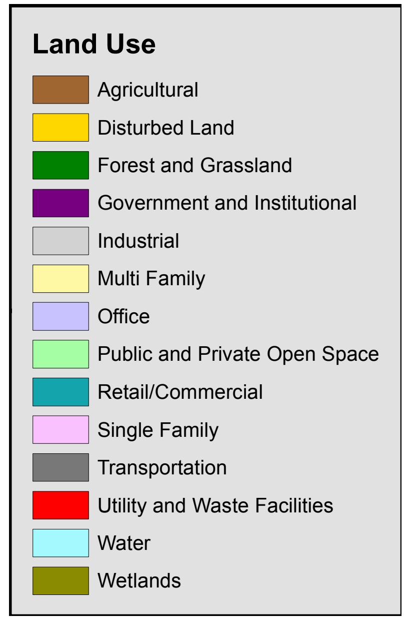
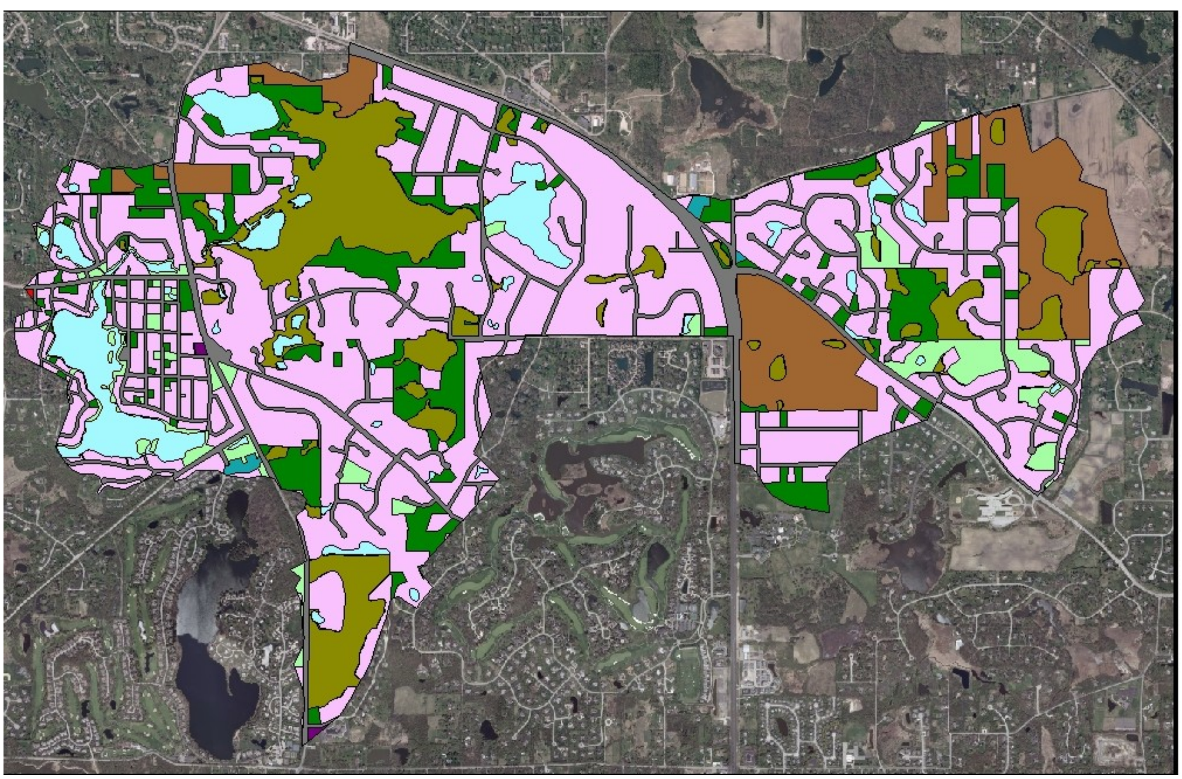


Figure 5. Land use within Tower lake watershed, (data collected from 2010 imagery).



CHLORIDES/CONDUCTIVITY

Conductivity measures the amount of ions contained in a waterbody. The more ions or salts that a waterbody contains the higher its conductivity. Conductivity can be used to estimate both total dissolved solids (TDS) and chloride concentrations due to a strong correlation between these parameters. LCHD-ES has decided in more recent years to analyze chloride concentrations due to a strong relationship discovered between road salt usage (which contains 40% chloride) and increasing chloride concentrations in lakes. Even more recently water softeners have been found to play an important role in increasing chloride concentrations in water. It only takes 1 teaspoon of salt (chloride) to pollute 5 gallons of water (230 mg/L). Once chlorides are in the water they remain there indefinitely, unless the water is somehow diluted or treated by a reverse osmosis system, the latter being a very expensive alternative.

It only takes1teaspoon of salt to pollute 5 gallons of water.

In 2013, the average chloride concentration in Tower Lake was 117 mg/L, this is a decrease of 46% from 2007 when the average chloride concentration was 171 mg/L. In 2013, chlorides ranged from 95 mg/L in July to a high of 141 mg/L in June, and were likely higher from snowmelt runoff early in spring. Chloride concentrations measured in Tower Lake were below the USEPA's critical concentration of 230 mg/L. Adverse impacts to a lakes ecosystem and its inhabitants are known to occur if the critical concentration is maintained for prolonged periods and shifts in algal populations have been documented at concentrations as low as 12 mg/L. Although chloride concentrations have significantly declined since 2007, single family and transportation are estimated to be the two highest contributors of runoff, and therefore residents should be thoughtful of their salt usage whether it be from winter maintenance or water treatment. The "What can I do to help?" tip box below, provides tips on how you can reduce salt use around your home.

The LCHD-ES and Lake County Stormwater Management Commission (LCSMC) have been holding annual training sessions targeting deicing maintenance personnel for both public and private entities. This is an attempt to educate winter road maintenance crews on the recommended application rates for applying deicers and hopefully will reduce the amount of chloride being introduced into our environment while maintaining safe passageways.

Almost all deicing products contain chloride so it is important to read the product label for proper application. For instance, at 10º Fahrenheit, rock salt is not at all effective in melting ice and will blow away before it melts anything. Homeowners should contact the local agency responsible for snow removal to encourage them to implement practices that reduce the usage of deicing products on their properties and roadways.

What can I do to help?

- Shovel (or use a snow blower) before you use any product; never put a deicing product on top of snow.
- Read the product label, before applying product.
- Sweep up un-dissolved product after a storm is over for reuse.
- Consider switching to a non-chloride deicer.
- Support changes in chloride application in your municipality.
- Inform a neighbor about the impacts chlorides have on our lakes rivers and streams.

Modified from (DuPage River Salt Creek Workgroup , 2008)

BEACHES

East Beach is monitored bi-weekly from Memorial Day until Labor Day unless elevated E-coli bacteria levels are detected. If that occurs a swim ban is issued and monitoring is conducted daily until E-coli counts go below the standard (235 colonies/100 mL). Since 2007, the beach has had nine swim bans; two in 2013, four in 2010, one in 2009 and two in 2008. To help reduce the number of swim bans, the LCHD-ES recommends that TLIA make additional efforts to discourage waterfowl from using the swim platforms at the swim areas; and when platforms are used and feces remain on the platform that they be physically removed from the lake rather than be swept off into the water.

ALGAE

In 2013, a blue-green algae was prevalent in the lake for a few days towards the end of July prompting the beach to close until it was treated and went away. Blue-green algae are cyanobacteria, and are considered an algae due to their ability to photosynthesize. They are a natural component in the plankton community and its not until HABs (harmful algal blooms) occur that there is need for concern, and even then toxins may not be present. It remains unclear what causes blue greens to release their toxins and the experts are currently investigating what causes this to happen. If HABs release toxins, they can have adverse effects upon public health and so caution is advised when dealing with them. The IEPA and the LCHD have initiated a program to collect HABs from beaches and test them for the presence of microcystin, a common toxin produced by HABs.

LCHD-ES checked the beach during the swim season and when the bloom occurred the sample turned out positive for microcystin, although at low concentrations, TLIA implemented a swim ban for a few days until the bloom cleared. Meanwhile the sample was sent out to an independent lab for enzyme-linked immunosorbent assay (ELISA) to confirm the concentration of microcystin in the sample. The World Health Organization standard for no contact is 20 ppb (ug/L) , the ELISA results came back well below this limit (Table 1).

In an attempt to educate residents about HABs, a fact sheet put out by the IEPA was given to TLIA for distribution.

Since it remains unclear what causes them to release toxin, it is recommended that HABs not be chemically treated, but left to complete their cycle. Other algae were noted to be in bloom on the lake throughout the entire summer. Records dating back to 2007 indicate that the lake frequently experiences algal blooms. For this reason, it is highly recommended that an action plan be developed determining what protocols will be followed in the event of another blue-green algae bloom, as it is highly probable that Tower Lake will experience future blooms.

Sample Date	Elisa ug/L	Test Strip
10-Jun	<0.15	NA
24-Jun	<0.15	NA
8-Jul	<0.15	NA
22-Jul	<0.15	NA
26-Jul	NA	2.5
29-Jul	8.23	5
31-Jul	0.37	0
31-Jul	5.82	1
5-Aug	0.19	NA
19-Aug	0.51	NA
17-Sep	NA	0

Table 1. Results from HAB samples in Tower Lake, 2013.

AQUATIC PLANTS

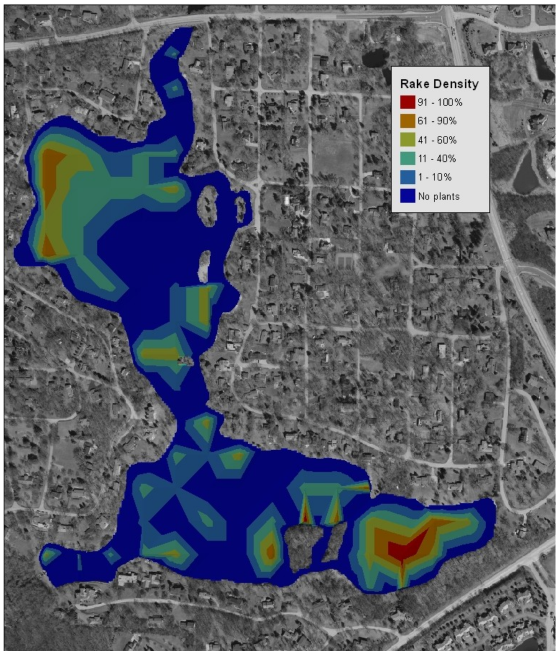


Figure 6. Rake density and location of aquatic vegetation in Tower Lake, 2013.

Aquatic plants are a critical feature in lakes as they compete against algae for nutrients, improve water quality and provide fish habitat for nesting and nursery. An aquatic vegetation survey was conducted in July, 2013. A 60-meter grid was randomly overlaid on an aerial photo of Tower Lake and a total of 71 points fell within the lake footprint and were assessed.

Fifty-four percent of the points sampled in Tower Lake were vegetated. It is estimated that the total plant density was 37% (Figure 6). There were four native plant species and Chara (a macroalgae) detected in the 2013 quantitative survey (Table 2). White Water Lily was the dominant species in the lake. There were no invasive plant species detected during our survey. LCHD-ES recommends allowing expansion of native plant populations to attain higher levels of cover. This will provide greater competitive pressure to algae and hopefully decrease their occurrence.

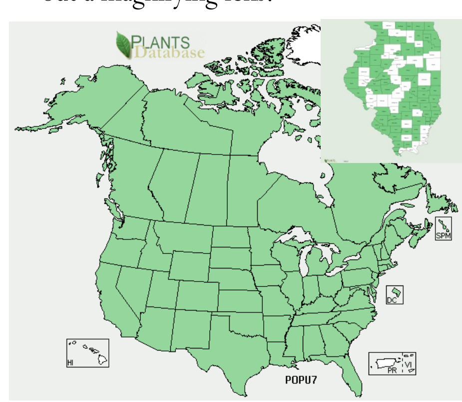
The diversity of plants remained the same as it was in 2007, however, the composition of plants has changed slightly. In 2013, Bladderwort and Small Pondweed replaced Sago Pondweed and Duckweed. Chara, Coontail and White Water Lily were present in both years. Due to the replacement of "weedier" native species by those with higher co-efficient of conservatism the floristic quality index (FQI) increased from 11.0 in 2007 to 14.0 in 2013. Floristic quality assessments are used in natural areas and allow for comparison among sites. An FQI of 35 is considered of marginal quality. Most lands in the Chicago region score an FQI of 20 or lower and essentially have no significance from a natural perspective (Swink and Wilhelm,1994). Tower Lake ranked 70th of 162 lakes assessed for floristic quality between 200 and 2013.

Table 2. Aquatic species detected in Tower Lake during 2013 quantitative survey.

Common Name	Scientific Name
Chara	Chara spp.
Bladderwort	*Utricularia vulgaris*
Coontail	*Ceratophyllum demeserum*
Small Pondweed	*Potomogeton pusillus*
White Water Lily	*Nymphae tuberosa*

SMALL PONDWEED

Small Pondweed (*Potomogeton pusillus),* a native submerged aquatic plant species tolerant to turbid water. A pair of glands where the leaf meets the stem is a distinguishing feature of this species, although this cannot be detected without a magnifying lens.



AQUATIC PLANT MANAGEMENT - PESTICIDES

FOR FULL DETAILS OF THE PESTICIDE RULE SEE:

HTTP://WWW.EPA.STATE.IL.US/WATER/PERMITS/PESTICIDE/INDEX.HTML

Tower Lake is a heavily managed lake. The lake is broken down into eleven management units (Figure 7). Rollins Aquatic Solutions, Inc., surveyed and treated the lake for aquatic vegetation and/or algae on eleven different occasions during the season, May - September. In May and June the focus of chemical treatments was Curlyleaf Pondweed. However, Coontail, Sago Pondweed, White Water Lily, Bladderwort, Duckweed and Watermeal were also targeted species during early season treatments as well as maintenance treatments occurring later in the season. In July, after many of the weeds had died, management of filamentous and blue-green algal blooms took place as well as additional management of Curlyleaf Pondweed and White Water Lily.

During the 2013 quantitative vegetation survey, the lake was found to have a total average density of 37%. LCHD-ES did not encounter any Curlyleaf Pondweed in the survey. White Water Lily was the dominant plant species found on the lake with an average density of 61%.

The LCHD-ES would like TLIA to consider designating areas for plants to colonize, and maintain those populations so they do not overtake the entire lake. It is a different strategy, that may help improve water clarity and suppress nuisance algal blooms; reducing the need for chemicals constantly being applied to Tower Lake.

TLIA was considering using a harvester to manage populations of White Water Lily. Due to the shallow nature of the lake, it is not recommended that this be pursued as scouring of the bottom by the harvester is likely to occur, which can further promote sediment and phosphorus into the water column impacting the overall water quality of Tower Lake.

Figure 7. Treatment area map for Tower Lake, 2013.

SHORELINE EROSION

Shoreline erosion contributes to poor water quality by increasing both the TSS and TP concentrations with either one of two outcomes, a very weedy lake due to an increase in a normally limiting nutrient (phosphorus) or a lake with few weeds due to decreased water clarity from excessive amounts of sediment or algae being in the water column. In a system without plants, algae can become a problem due to the lack of competition for nutrients by plants. Sedimentation can also cause destruction of habitat for fish and other macroinvertebrates due to the deposition of sediment on nests and plants.

In 2013, 44% percent of the 3.22 mile shoreline was experiencing some degree of erosion (Figure 8). The amount of eroding shorelines has decreased since 2007 when 62% of the shoreline exhibited some degree of erosion. The decrease in the amount of erosion encountered was the result of TLIA remediating areas that were previously documented as having some degree of erosion. Thirty-eight percent of the erosion present on Tower Lake in 2013 was either slight (22%) or moderate (16%). Undercutting of previous control efforts due to the use of undersized rip rap and unattended eroding shorelines made up a majority of the erosion problems found in 2013. Water level fluctuations on Tower Lake over the course of the season was 0.5 feet, however in August there was a fluctuation measuring 1.1 feet, fluctuations of this magnitude can contribute to eroding shorelines.

LCHD-ES recommends minimizing shoreline slopes when ever possible, and using a mix of hardscaping (i.e. rip rap) and plantings of shorelines with native plants (Figure 9). Native plants have deep root systems that are able to more efficiently secure soils than the short root system present in turf grass which abuts the water along many of the shoreline areas.

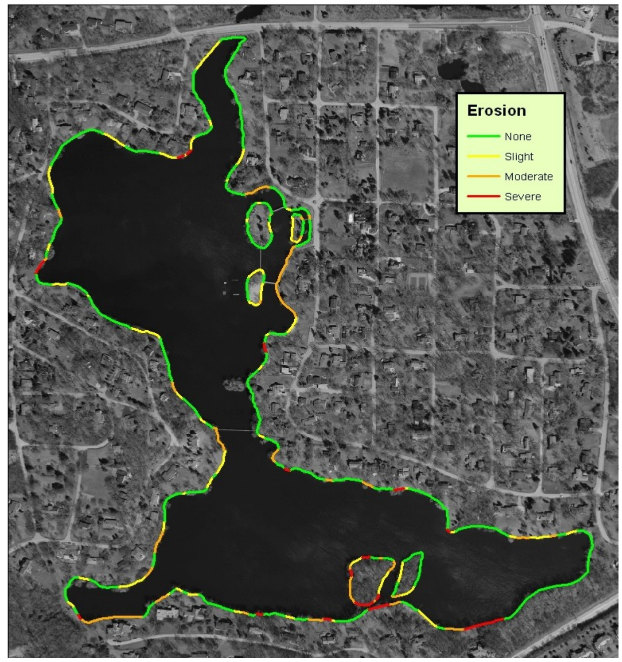


Figure 8. Shoreline erosion assessed on Tower Lake, 2013.

Figure 9. Example of using hardscaping and native plantings

Table 3. Degree of erosion on Tower Lake, 2013

Erosion	Miles	Percent
None	1.79	56%
Slight	0.72	22%
Moderate	0.53	16%
Severe	0.18	6%

DISSOLVED OXYGEN (DO)

Dissolved Oxygen (DO) is essential for the survival of fish and invertebrates and influences many different biological and chemical processes in lakes.

Tower Lake exhibits polymictic tendencies; therefore the lowest hypoxia may not be observed in Tower Lake at all times. DO concentrations of ≤2 mg/L in the water near the lake bottom are low enough to cause hypoxia in the bottom sediments and phosphorus release to occur. DO concentrations in Tower Lake do become anoxic near the bottom in July and August. The result is soluble reactive phosphorus (SRP) in the water during August due to there being just too much phosphorus in the system and organisms could no longer take it up. SRP is the biologically available form of phosphorus, and is usually taken up immediately by aquatic organisms. Since Tower Lake is a phosphorus limited lake, any additional phosphorus will fuel plant and algal growth and should be avoided. TLIA may want to consider installing an aeration system into Tower Lake. It is estimated that a minimum of 6.02 horsepower would be required to destratify the lake.

DO is considered supersaturated when % DO is elevated above 100%. DO saturation greater than 110% that is maintained in the water for extended periods of time can begin to impact fish. In rare cases, excessive DO can lead to gas bubble disease, where oxygen bubbles or emboli block the blood flow through blood vessels. Tower Lake had elevated % DO occurring in the water column for the entire season (May through August). In June, the entire water column was supersaturated with % DO from 109% at the surface to 125% at the bottom. The elevated % DO was likely due to photosynthesizing algae. The death of algae or plants can additionally contribute to low DO conditions.

FISH

A survey of the Tower Lake fish population was last conducted by the IDNR in 2007. At that time, eleven different fish species (Table 3) were detected during 60 minutes of daytime electro-fishing. If one of TLIA's goals is to manage Tower Lake as a sport fishery, they should follow the recommendations made by the IDNR fish biologist in his 2008 report such as; establishing reasonable length and harvest limits, removal of carp and yellow bass from the lake when caught, and alternating the stocking of 10" fingerling northern pike and non-vulnerable (8"-12") channel cats at two per acre on alternate years to diversify the predator base. Channel catfish do not reproduce well in small lakes so will need to be stocked, this will maintain the population of this species. It was also recommended by the IDNR biologist that the plan agreed upon by the TLIA be followed.

Table 3. Fish species detected in 2007 survey conducted by IDNR fish biologist.

SPECIES	NUMBER
LARGEMOUTH BASS	89
BLUEGILL	195
PUMPKINSEED SUNFISH	1
GREEN SUNFISH	1
SUNFISH HYBRID	1
WARMOUTH	6
BLACK CRAPPIE	25
YELLOW BASS	24
NORTHERN PIKE	2
BLACK BULLHEAD	1
CARP	16
SPECIES= 11 TOTAL=	361

VLMP

Tower Lake had volunteers participate in the VLMP program in 2012 and 2013. In 2012, Dustin Good collected Secchi depths and in 2013, a team of volunteers participated in collecting Secchi data on Tower Lake. The team consisted of Rich Bahr, Steve Barten, Andy Hay, Dan Hay and Tom Kabula.

Figure 10 shows the average Secchi depths for the three VLMP sites (Appendix A, Figure 9) during 2012 and 2013. In 2012, the average Secchi depths were; 2.69 feet (VLMP1), 2.56 feet (VLMP2), and 2.27 feet (VLMP3). In 2013, the average Secchi depths were 2.53 feet (VLMP1), 2.88 feet (VLMP2), and 2.60 feet (VLMP3).

All of the average Secchi depths measured by the VLMPs during these years were below the 3.00 feet median Secchi depth for lakes in the county whose depths have been recorded from 2000 to 2013.

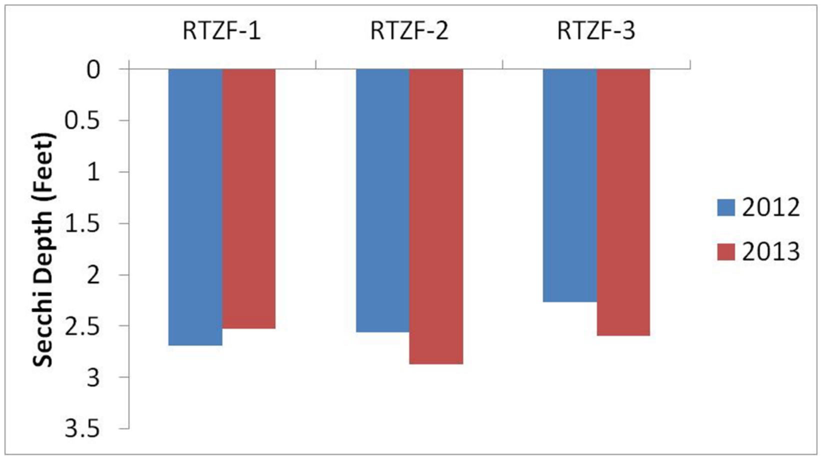


Figure 10. 2012 and 2013 average secchi depths for VLMP sites on Tower Lake.

BATHYMETRIC MAP

Tower Lake is lacking an updated bathymetric map. LCHD-ES recommends that an updated bathymetric map be secured every fifteen years. The current bathymetric map dates back from data collected in 1988 (Figure 11).

A bathymetric map is a useful tool for lake managers as it assists in tasks such as estimating volumes for lake treatment and other decisions involved with the overall plant management plan. It also allows for evaluation of anoxic water volumes which helps in managing and maintaining a fishery.

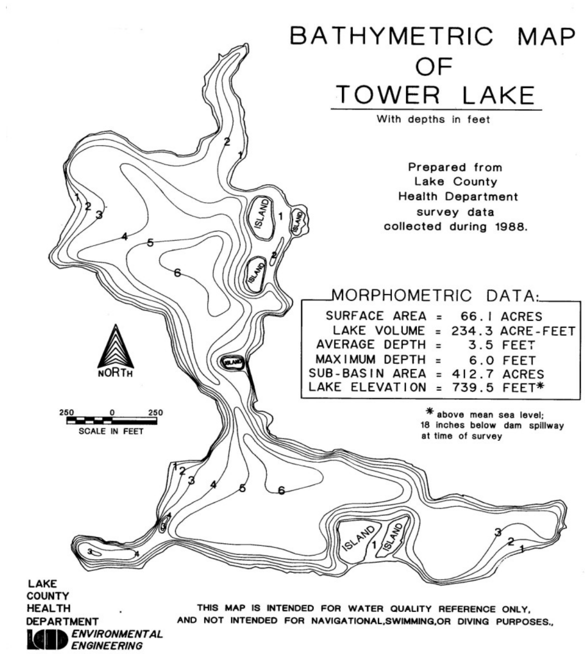


Figure 11. Bathymetric map of Tower Lake, 1988.

ZEBRA MUSSELS

Zebra mussels (*Dreissena polymorpha*) were noted as being present in Tower Lake in 2013 by the VLMPs; however the LCHD-ES did not detect them in any of their surveys. Zebra mussels are believed to have been spread to this country in the mid 1980's by cargo ships from Europe that discharged their ballast water into the Great Lakes. The mussels spread throughout the Great Lakes and by 1991 had made their way into the Illinois and Mississippi Rivers. In 1999, the first sighting of the mussel in Lake County (besides Lake Michigan and the Chain of Lakes) occurred. In 2001, zebra mussels were discovered in Tower Lake, which drains into the Tower Drain and eventually the Fox River. Currently, 34 inland lakes in the County are known to be infested with the zebra mussel, but this number could be much higher, since the mussel has probably gone unnoticed in many lakes. Due to their quick life cycle and explosive growth rate, zebra mussels can quickly edge out native mussel species. Negative impacts on native bivalve populations include interferences with feeding, habitat, growth, movement and reproduction. The impact that the mussels have on fish populations is not fully understood. However, zebra mussels feed on algae, which are also a major food source for planktivorous fish, such as bluegills, which in turn are food for predators like bass and pike. Recent studies on the transport of the zebra mussel have shown that they can be found in any area of a boat that holds water, including the engine cooling system, bilge water, and bait buckets used in fishing. Researchers found that many of the mussel larvae were being transported via aquatic plants that were taken from one lake to another on boats and trailers. It is important that all boats and trailers entering or leaving Tower Lake are inspected for aquatic plants and zebra mussels. A biocide called Zequanox is currently under testing in a Du Page County lake. Zequanox has shown to be effective in controlling zebra mussels in lab studies and it is not toxic to humans, native bivalves, and fish.

SEDIMENT REMOVAL

An area from Davlins Pond to Robert's Road bridge was part of a sediment removal project in 2013. Sediment bladders were placed in an area beyond the outlet of North Tower Lake (Figure 12) and allowed to drain into the segment of stream between North Tower and Davlins Pond. Silt fencing was installed around wetland and stream corridors to assure that no sediments would impact those areas.

Figure 12. Sediment bladder for sediment removal project near Tower Lake, 2013.

Environmental Services

Senior Biologist: Mike Adam

madam@lakecountyil.gov

Population Health Services
500 W. Winchester Road
Libertyville, Illinois 60048-1331

Phone: 847-377-8030
Fax: 847-984-5622

For more information visit us at:

http://www.lakecountyil.gov/Health/want/BeachLakeInfo.htm

Protecting the quality of our lakes is an increasing concern of Lake County residents. Each lake is a valuable resource that must be properly managed if it is to be enjoyed by future generations. To assist with this endeavor, Population Health Environmental Services provides technical expertise essential to the management and protection of Lake County surface waters.

Environmental Service's goal is to monitor the quality of the county's surface water in order to:

- Maintain or improve water quality and alleviate nuisance conditions
- Promote healthy and safe lake conditions
- Protect and improve ecological diversity

Services provided are either of a technical or educational nature and are provided by a professional staff of scientists to government agencies (county, township and municipal), lake property owners' associations and private individuals on all bodies of water within Lake County.

Recommendations

LCHD-ES recommends the following actions for improving the water quality and overall health of Tower Lake:

- Use best management practices to reduce phosphorus and nitrogen from being introduced into the lake. Practices such as phosphorus-free fertilizers, discouraging activities that promote healthy goose populations, and keeping yard waste out of the lake are among the practices recommended.
- Promote the spread of native vegetation in areas of Tower Lake to help improve water quality, reduce algal populations and to provide fish habitat.
- Repair eroding shorelines. This can be accomplished through a mix of hardscaping and native plantings. Proper rock size and installation is necessary to ensure long term success.
- Develop a plan of action on how to handle future blue-green algal blooms on Tower Lake so that there is a standard procedure in place that can be followed.

STOP AQUATIC HITCHHIKERS!™

Prevent the transport of nuisance species.
Clean all recreational equipment.
www.ProtectYourWaters.net

When you leave a body of water:

- Remove any visible mud, plants, fish or animals before transporting equipment.
- Eliminate water from equipment before transporting.
- Clean and dry anything that comes into contact with water (boats, trailers, equipment, clothing, dogs, etc.).
- Never release plants, fish or animals into a body of water unless they came out of that body of water.

APPENDIX A

FIGURES AND TABLES
TOWER LAKE
2013

Figure 1. LCHD water quality sampling point – Tower Lake 2013.

Figure 2. Approximate watershed boundary of Tower Lake, 2013.

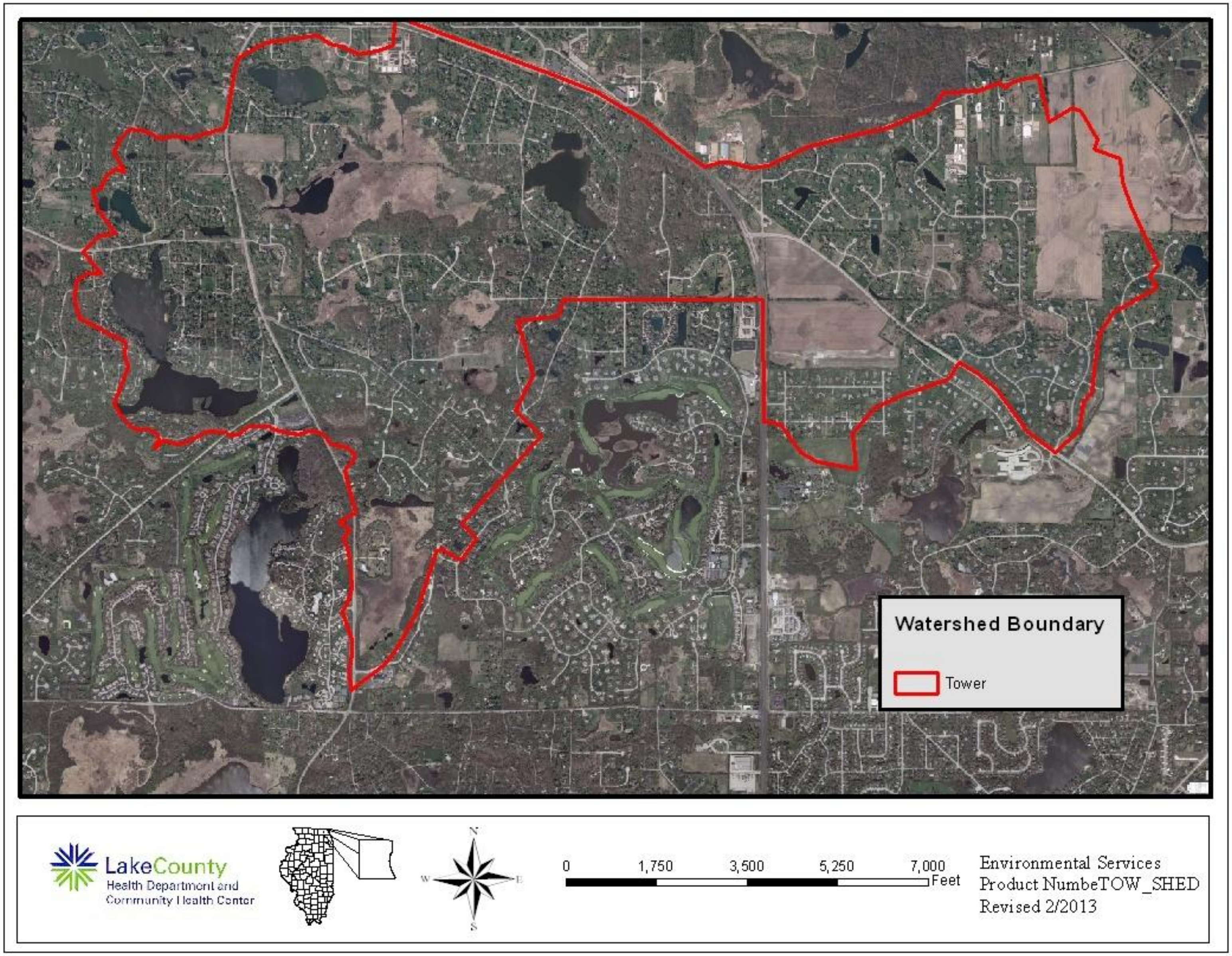
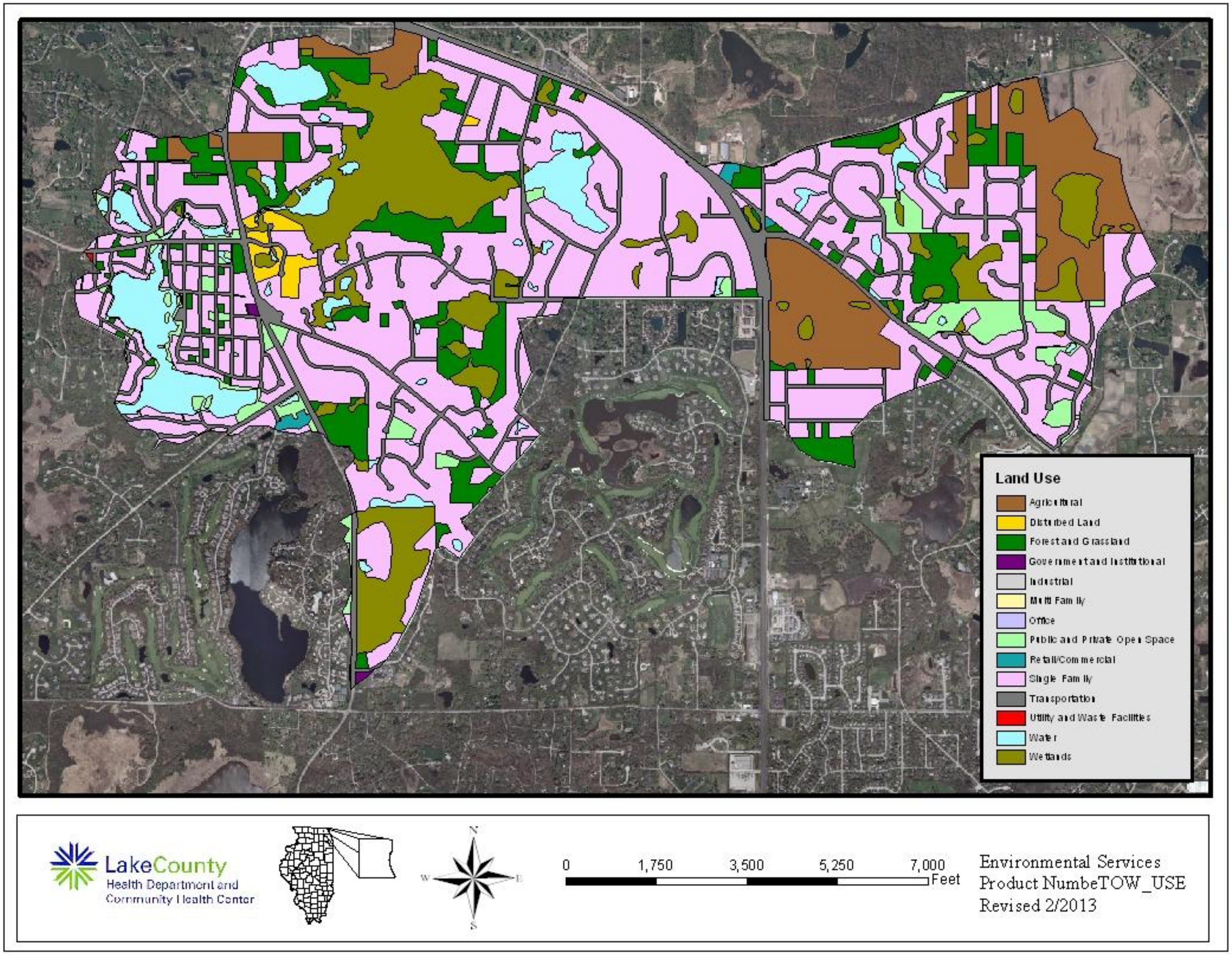


Figure 3. Land use of Tower Lake watershed, 2013. Based upon 2010 imagery.



.

Table 1. Approximate land uses and retention time for Tower Lake, 2013.

Land Use	Acreage	% of Total
Agricultural	272.20	9.8%
Disturbed Land	0.00	0.0%
Forest and Grassland	266.15	9.5%
Government and Institutional	2.02	0.1%
Industrial	0.00	0.0%
Multi Family	0.00	0.0%
Office	0.00	0.0%
Public and Private Open Space	99.98	3.6%
Retail/Commercial	6.96	0.2%
Single Family	1302.42	46.7%
Transportation	315.73	11.3%
Utility and Waste Facilities	0.32	0.0%
Water	174.98	6.3%
Wetlands	349.80	12.5%
Total Acres	**2790.57**	**100.0%**

Land Use	Acreage	Runoff Coeff.	Estimated Runoff, acft.	% Total of Estimated Runoff
Agricultural	272.20	0.05	37.4	1.9
Disturbed Land	0.00	0.05	0.0	0.0
Forest and Grassland	266.15	0.05	36.6	1.8
Government and Institutional	2.02	0.50	2.8	0.1
Industrial	0.00	0.80	0.0	0.0
Multi Family	0.00	0.50	0.0	0.0
Office	0.00	0.85	0.0	0.0
Public and Private Open Space	99.98	0.15	41.2	2.1
Retail/Commercial	6.96	0.85	16.3	0.8
Single Family	1302.42	0.30	1074.5	53.9
Transportation	315.73	0.85	738.0	37.0
Utility and Waste Facilities	0.32	0.30	0.3	0.0
Water	174.98	0.00	0.0	0.0
Wetlands	349.80	0.05	48.1	2.4
TOTAL	**2790.57**		**1995.2**	**100.0**

Lake volume	**234.30**	**acre-feet**
Retention Time (years)= lake volume/runoff	**0.12**	**years**
	42.86	**days**

Table 2. Water chemistry of Tower Lake, 2013, 2007 and 2001.

2013	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	TDS**	Cl	TSS	TS	TVS	SECCHI	COND	pH	DO
21-May	3	180	1.06	<0.100	<0.05	0.040	<0.005	430	138	2.7	533	114	1.57	0.7601	8.20	8.20
18-Jun	3	191	1.11	<0.100	<0.05	0.048	<0.005	510	141	3.2	559	125	4.50	0.9197	8.27	11.81
16-Jul	3	180	1.39	<0.100	<0.05	0.112	0.018	384	95	7.4	435	103	2.45	0.6685	8.08	9.27
20-Aug	3	191	1.96	<0.100	<0.05	0.093	<0.005	395	103	10.0	446	104	1.85	0.6914	8.30	6.91
17-Sep	3	194	2.57	<0.100	<0.05	0.122	<0.005	384	107	23.4	456	111	1.20	0.6688	8.27	9.56
	Average	187	1.62	<0.1	<0.05	0.083	0.018^k	420	117	9.3	486	111	2.31	0.7417	8.22	9.15

2007	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	TDS**	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
9-May	3	243	0.94	<0.100	<0.05	0.028	<0.005	606	182	3.1	620	103	6.56	1.1110	8.20	9.85
13-Jun	3	219	1.04	<0.100	<0.05	0.047	<0.005	586	189	4.2	642	146	6.40	1.0720	8.36	8.72
11-Jul	3	220	1.41	<0.100	<0.05	0.068	<0.005	606	182	9.3	642	150	3.94	1.1110	8.53	7.36
8-Aug	3	182	1.36	<0.100	<0.05	0.101	0.009	538	179	6.8	560	124	2.36	0.9750	8.31	8.74
12-Sep	3	225	1.55	<0.100	<0.05	0.087	<0.005	538	124	12.0	519	104	2.30	0.8580	8.10	8.90
	Average	218	1.26	<0.1	<0.05	0.066	0.009^k	575	171	7.1	597	125	4.31	1.0254	8.30	8.71

2001	Epilimnion															
DATE	DEPTH	ALK	TKN	NH3	NO_3-N*	TP	SRP	TDS	Cl^-**	TSS	TS	TVS	SECCHI	COND	pH	DO
23-May	3	252	0.80	0.233	<0.05	0.060	0.011	672	228	14.6	688	180	2.26	1.1020	7.69	5.52
27-Jun	3	240	1.60	<0.100	<0.05	0.056	<0.005	672	230	5.60	705	177	4.50	1.1070	8.13	8.70
1-Aug	3	199	1.71	<0.100	<0.05	0.101	0.011	620	211	12.0	679	215	2.20	1.0490	8.30	9.05
29-Aug	3	184	2.16	<0.100	<0.05	0.162	0.005	583	201	26.2	691	257	1.05	1.0160	8.43	9.50
25-Sep	3	177	1.83	<0.100	<0.05	0.121	0.019	570	196	16.8	617	171	1.54	0.9981	7.93	7.77
	Average	210	1.62	0.233^k	<0.05	0.100	0.012^k	623	213	15.0	676	200	2.31	1.0544	8.10	8.11

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_3-N = Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
TDS = Total dissolved solids, mg/L
TSS = Total suspended solids, mg/L
TS = Total solids, mg/L
TVS = Total volatile solids, mg/L
SECCHI = Secchi Disk Depth, Ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

k = Denotes that the actual value is known to be less than the value presented.
NA= Not applicable
** Estimate from Conductivity.
*Prior to 2007 only nitrate NO_3 was measured.

Figure 4. Water clarity (Secchi depth) of Tower Lake, 2001, 2007 and 2013.

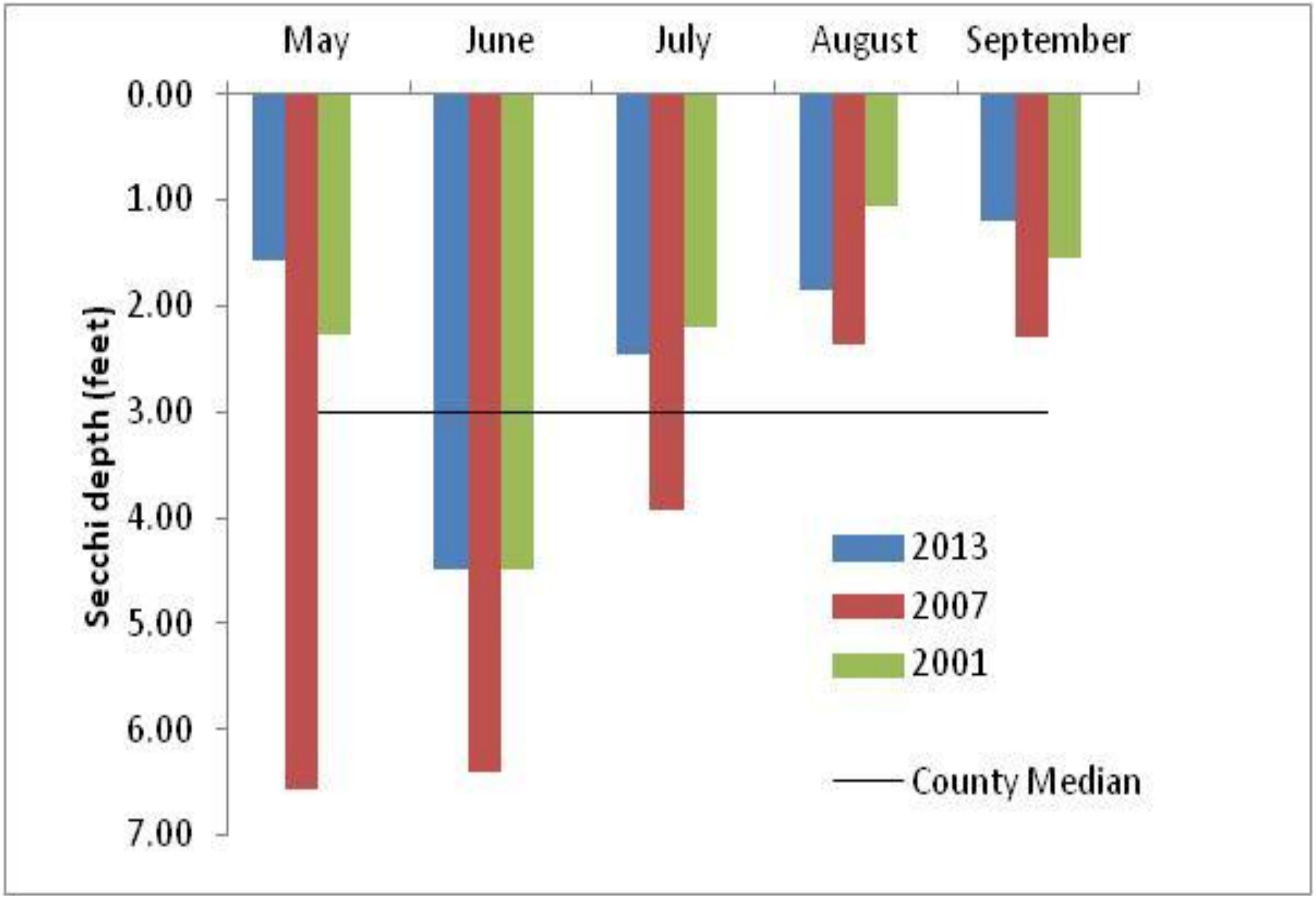


Table 3. 2000 - 2013 water quality parameters, statistics summary.

	ALKoxic <=3ft00-2013	
Average	**164**	
Median	**159**	
Minimum	**65**	**IMC**
Maximum	**330**	**Flint Lake**
STD	**42**	
n =	**863**	

	ALKanoxic 2000-2013	
Average	**198**	
Median	**187**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**53**	
n =	**231**	

	Condoxic <=3ft00-2013	
Average	**0.8667**	
Median	**0.7875**	
Minimum	**0.2260**	**Schreiber Lake**
Maximum	**6.8920**	**IMC**
STD	**0.5239**	
n =	**860**	

	Condanoxic 2000-2013	
Average	**1.0056**	
Median	**0.8360**	
Minimum	**0.3210**	**Lake Kathyrn, Schreiber Lake**
Maximum	**7.4080**	**IMC**
STD	**0.8091**	
n =	**231**	

	NO3-N, Nitrate+Nitrite,oxic <=3ft00-2013	
Average	**0.454**	
Median	**0.145**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.016**	
n =	**863**	

*ND = Many lakes had non-detects (74.5%)
Only compare lakes with detectable
concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

	NH3-Nanoxic 2000-2013	
Average	**2.211**	
Median	**1.530**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.425**	
n =	**231**	

*ND = 29.1% Non-detects from 32 different lakes

	pHoxic <=3ft00-2013	
Average	**8.35**	
Median	**8.34**	
Minimum	**7.06**	**Deer Lake**
Maximum	**10.40**	**Summerhill Estates**
STD	**0.46**	
n =	**860**	

	pHanoxic 2000-2013	
Average	**7.27**	
Median	**7.24**	
Minimum	**6.24**	**Cranberry Lake, Banana Pond**
Maximum	**9.16**	**White Lake**
STD	**0.45**	
n =	**231**	

	All Secchi 2000-2013	
Average	**4.35**	
Median	**3.00**	
Minimum	**0.18**	**McDonald 2/Ozaukee/Rollins 2**
Maximum	**29.23**	**Bangs Lake**
STD	**3.63**	
n =	**783**	

LakeCounty
Health Department and
Community Health Center

Table 3. 2000 - 2013 water quality parameters, statistics summary.

	TKNoxic <=3ft00-2013	
Average	**1.525**	
Median	**1.170**	
Minimum	**<0.1**	***ND**
Maximum	**41.200**	**Almond Marsh**
STD	**1.726**	
n =	**863**	

*ND = 3.5% Non-detects from 14 different lakes

	TKNanoxic 2000-2013	
Average	**2.891**	
Median	**2.210**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.372**	
n =	**231**	

*ND = 3.5% Non-detects from 4 different lakes

	TPoxic <=3ft00-2013	
Average	**0.114**	
Median	**0.067**	
Minimum	**<0.01**	***ND**
Maximum	**7.270**	**Almond Marsh**
STD	**0.276**	
n =	**863**	

*ND = 1.8% Non-detects from 6 different lakes

	TPanoxic 2000-2013	
Average	**0.323**	
Median	**0.180**	
Minimum	**0.012**	**Independence Grove, W. Loon**
Maximum	**3.800**	**Taylor Lake**
STD	**0.410**	
n =	**231**	

	TSSall <=3ft00-2013	
Average	**15.8**	
Median	**8.0**	
Minimum	**<1**	***ND**
Maximum	**220.0**	**Rollins 2**
STD	**22.5**	
n =	**848**	

*ND = 1.3% Non-detects from 8 different lakes

	TVSoxic <=3ft00-2013	
Average	**124.7**	
Median	**119.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**1090.0**	**Almond Marsh**
STD	**50.7**	
n =	**818**	

No 2002 IEPA Chain Lakes

	TDSoxic <=3ft00-2004	
Average	**470**	
Median	**454**	
Minimum	**150**	**Lake Kathryn, White**
Maximum	**1340**	**IMC**
STD	**169**	
n =	**745**	

No 2002 IEPA Chain Lakes.

	CLanoxic 2000-2013	
Average	**195**	
Median	**135**	
Minimum	**3.5**	**Schreiber Lake**
Maximum	**2390**	**IMC**
STD	**310**	
n =	**178**	

	CLoxic 2000-2013	
Average	**179**	
Median	**145**	
Minimum	**2.7**	**Schreiber Lake**
Maximum	**2760**	**IMC**
STD	**200**	
n =	**723**	

Anoxic conditions are defined <=1 mg/l D.O.
pH Units are equal to the -Log of [H] ion activity
Conductivity units are in MilliSiemens/cm
Secchi Disk depth units are in feet
All others are in mg/L

Minimums and maximums are based on data from all lakes from 2000-2013 (n=4476).

Average, median and STD are based on data from the most recent water quality sampling year for each lake.

LCHD Environmental Services ~ 1/21/2014

LakeCounty
Health Department and
Community Health Center

Table 4. Average Secchi depths measured from lakes in Lake County, 2000-2013.

RANK	LAKE NAME	SECCHI AVE	TSIsd
1	Windward Lake	14.28	38.8
2	Lake Carina	13.21	39.9
3	Druce Lake	12.25	41.0
4	Pulaski Pond	11.69	41.7
5	West Loon Lake	11.55	41.9
6	Independence Grove	11.50	41.9
7	Sterling Lake	11.35	42.1
8	Lake Zurich	10.40	43.4
9	Davis Lake	9.65	44.4
10	Harvey Lake	9.47	44.7
11	Little Silver Lake	9.42	44.8
12	Old School Lake	9.40	44.8
13	Lake Kathryn	9.39	44.8
14	Dugdale Lake	9.22	45.1
15	Dog Training Pond	9.04	45.4
16	Bangs Lake	8.90	45.0
17	Banana Pond	8.85	45.7
18	Deep Lake	8.83	45.7
19	Stone Quarry Lake	8.81	45.8
20	Lake of the Hollow	8.74	45.9
21	Cedar Lake	8.25	47.0
22	Cross Lake	8.18	46.8
23	Ames Pit	8.14	46.9
24	Briarcrest Pond	8.00	47.1
25	Cranberry Lake	7.88	46.0
26	Sand Lake	7.48	48.1
27	Sand Pond (IDNR)	7.42	48.2
28	Timber Lake (North)	7.37	48.3
29	Lake Miltmore	7.35	48.4
30	Lake Leo	7.31	48.4
31	Schreiber Lake	7.25	48.6
32	Nielsen Pond	7.23	48.6
33	Honey Lake	7.17	48.7
34	Lake Minear	7.13	48.8
35	Round Lake	7.01	49.1
36	Highland Lake	6.97	49.1
37	Channel Lake	6.65	49.8
38	Third Lake	6.60	50.0
39	Lake Catherine	6.58	50.0
40	Lake Helen	6.43	50.3
41	Sun Lake	6.33	50.5
42	Wooster Lake	6.21	51.0
43	Lake Barrington	6.12	51.0
44	Lake Fairfield	5.89	51.6
45	Countryside Lake	5.56	52.0
46	Gages Lake	5.45	52.7
47	Owens Lake	5.30	53.1
48	Valley Lake	5.05	53.8

Table 4. Average Secchi depths measured from lakes in Lake County, 2000-2013.

RANK	LAKE NAME	SECCHI AVE	TSIsd
49	McGreal Lake	5.04	53.8
50	Old Oak Lake	4.85	54.4
51	Waterford Lake	4.70	54.8
52	Lake Linden	4.60	55.1
53	Peterson Pond	4.51	55.4
54	Timber Lake (South)	4.46	56.0
55	Crooked Lake	4.39	55.8
56	Mary Lee Lake	4.35	55.9
57	Butler Lake	4.35	55.9
58	Crooked Lake	4.28	56.2
59	Deer Lake	4.20	56.4
60	Seven Acre Lake	4.18	56.5
61	Lambs Farm Lake	4.17	56.5
62	Grays Lake	4.08	56.9
63	Lake Naomi	4.05	57.0
64	White Lake	3.96	57.3
65	Hook Lake	3.95	57.3
66	Turner Lake	3.92	57.4
67	North Tower Lake	3.89	60.0
68	Leisure Lake	3.85	57.7
69	Salem Lake	3.77	58.0
70	Lake Fairview	3.75	58.0
71	Countryside Glen Lake	3.64	58.5
72	Taylor Lake	3.52	59.0
73	Hastings Lake	3.52	59.0
74	Duck Lake	3.49	59.1
75	Fish Lake	3.47	59.2
76	Bishop Lake	3.47	59.2
77	Lake Lakeland Estates	3.41	59.0
78	Lake Holloway	3.40	59.5
79	Stockholm Lake	3.38	59.6
80	East Loon Lake	3.30	59.9
81	Bresen Lake	3.28	60.0
82	Summerhill Estates Lake	3.27	60.0
83	Lucky Lake	3.22	60.3
84	Diamond Lake	3.17	60.5
85	Liberty Lake	3.16	60.5
86	International Mining and Chemical Lake	3.08	60.9
87	Lake Christa	3.01	61.2
88	Lucy Lake	2.99	61.3
89	Long Lake	2.87	62.0
90	Bluff Lake	2.85	62.0
91	St. Mary's Lake	2.79	62.3
92	Werhane Lake	2.71	62.8
93	Petite Lake	2.66	63.0
94	East Meadow Lake	2.61	63.3
95	Buffalo Creek Reservoir 1	2.60	64.0
96	Kemper Lake 1	2.56	63.6

Table 4. Average Secchi depths measured from lakes in Lake County, 2000-2013.

RANK	LAKE NAME	SECCHI AVE	TSIsd
97	Broberg Marsh	2.50	63.9
98	Antioch Lake	2.48	64.0
99	Spring Lake	2.46	64.2
100	Little Bear Lake	2.38	64.6
101	Island Lake	2.32	65.0
102	Tower Lake	2.31	56.0
103	Buffalo Creek Reservoir 2	2.30	67.0
104	Woodland Lake	2.28	65.0
105	Lake Marie	2.25	65.4
106	Rivershire Pond 2	2.23	65.6
107	Lake Charles	2.20	65.8
108	College Trail Lake	2.18	65.9
109	Loch Lomond	2.17	66.0
110	Echo Lake	2.11	66.4
111	Eagle Lake (S1)	2.10	66.4
112	West Meadow Lake	2.07	66.6
113	Forest Lake	2.04	66.9
114	Grand Ave Marsh	2.03	66.9
115	Columbus Park Lake	2.03	66.9
116	Grassy Lake	2.00	67.1
117	Sylvan Lake	1.98	67.3
118	Bittersweet Golf Course #13	1.98	67.3
119	Fischer Lake	1.96	67.4
120	Pistakee Lake	1.88	68.0
121	Kemper Lake 2	1.77	68.9
122	Fourth Lake	1.77	68.9
123	Nippersink Lake	1.73	69.2
124	Deer Lake Meadow Lake	1.73	69.2
125	Lake Louise	1.68	69.7
126	Willow Lake	1.63	70.1
127	Slough Lake	1.63	70.1
128	Rasmussen Lake	1.62	70.2
129	Lake Farmington	1.62	70.2
130	Half Day Pit	1.60	70.4
131	Dunn's Lake	1.54	70.9
132	Longview Meadow Lake	1.51	71.2
133	Lake Matthews	1.41	72.2
134	Fox Lake	1.37	72.6
135	Grass Lake	1.33	73.0
136	Big Bear Lake	1.32	73.1
137	Lake Nippersink	1.28	73.6
138	Redhead Lake	1.27	73.7
139	Lake Eleanor	1.16	75.0
140	McDonald Lake 1	1.13	75.4
141	Lake Napa Suwe	1.06	105.0
142	Rollins Savannah 1	1.05	76.4
143	Osprey Lake	1.03	76.7
144	Manning's Slough	1.00	77.1

Table 4. Average Secchi depths measured from lakes in Lake County, 2000-2013.

RANK	LAKE NAME	SECCHI AVE	TSIsd
145	Rollins Savannah 2	0.95	77.9
146	Dog Bone Lake	0.94	78.0
147	Redwing Marsh	0.88	79.0
148	Flint Lake Outlet	0.83	79.8
149	Slocum Lake	0.81	80.0
150	Fairfield Marsh	0.81	80.2
151	Oak Hills Lake	0.79	80.5
152	South Churchill Lake	0.73	81.7
153	Lake Forest Pond	0.71	82.1
54	ADID 127	0.66	83.1
155	North Churchill Lake	0.61	84.3
156	Hidden Lake	0.56	85.5
157	Ozaukee Lake	0.51	86.8
158	McDonald Lake 2	0.50	87.1

Table 5. Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
1	Lake Carina	0.0100	37.35
2	Sterling Lake	0.0100	37.35
3	Independence Grove	0.0130	41.14
4	Lake Zurich	0.0135	41.68
5	Druce Lake	0.0140	42.00
6	Windward Lake	0.0160	44.13
7	Sand Pond (IDNR)	0.0165	44.57
8	West Loon	0.0170	45.00
9	Pulaski Pond	0.0180	45.83
10	Banana Pond	0.0200	47.35
11	Cedar Lake	0.0200	47.35
12	Gages Lake	0.0200	47.35
13	Lake Kathryn	0.0200	47.35
14	Lake Minear	0.0200	47.35
15	Highland Lake	0.0202	47.49
16	Lake Miltmore	0.0210	48.00
17	Timber Lake (North)	0.0210	48.05
18	Cross Lake	0.0220	48.72
19	Dog Training Pond	0.0220	48.72
20	Sun Lake	0.0220	48.72
21	Deep Lake	0.0230	49.36
22	Lake of the Hollow	0.0230	49.36
23	Round Lake	0.0230	49.36
24	Stone Quarry Lake	0.0230	49.36
25	Bangs Lake	0.0240	50.00
26	Little Silver Lake	0.0250	50.57
27	Lake Leo	0.0260	51.13
28	Cranberry Lake	0.0270	51.68
29	Dugdale Lake	0.0270	51.68
30	Peterson Pond	0.0270	51.68
31	Fourth Lake	0.0360	53.00
32	Lake Fairfield	0.0300	53.20
33	Third Lake	0.0300	53.20
34	Lake Catherine	0.0310	53.67
35	Lambs Farm Lake	0.0310	53.67
36	Old School Lake	0.0310	53.67
37	Grays Lake	0.0310	54.00
38	Harvey Lake	0.0320	54.50
39	Hendrick Lake	0.0340	55.00
40	Honey Lake	0.0340	55.00
41	Sand Lake	0.0380	56.00
42	Sullivan Lake	0.0370	56.22
43	Channel Lake	0.0380	56.60
44	Ames Pit	0.0390	56.98
45	Diamond Lake	0.0390	56.98
46	East Loon	0.0400	57.34
47	Schreiber Lake	0.0400	57.34
48	Waterford Lake	0.0400	57.34
49	Hook Lake	0.0410	57.70
50	Duck Lake	0.0430	58.39
51	Nielsen Pond	0.0450	59.04
52	Seven Acre Lake	0.0460	59.36

Table 5. Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
53	Turner Lake	0.0460	59.36
54	Willow Lake	0.0460	59.36
55	East Meadow Lake	0.0480	59.97
56	Lucky Lake	0.0480	59.97
57	Old Oak Lake	0.0490	60.27
58	College Trail Lake	0.0500	60.56
59	Hastings Lake	0.0520	61.13
60	Butler Lake	0.0530	61.40
61	West Meadow Lake	0.0530	61.40
62	Lucy Lake	0.0550	61.94
63	Lake Linden	0.0570	62.45
64	Lake Christa	0.0580	62.70
65	Owens Lake	0.0580	62.70
66	Briarcrest Pond	0.0580	63.00
67	Lake Barrington	0.0600	63.10
68	Lake Lakeland Estates	0.0620	63.66
69	Lake Naomi	0.0620	63.66
70	Lake Tranquility (S1)	0.0620	63.66
71	Liberty Lake	0.0630	63.89
72	North Tower Lake	0.0630	63.89
73	Werhane Lake	0.0630	63.89
74	Countryside Glen Lake	0.0640	64.12
75	Countryside Lake	0.0660	65.00
76	Davis Lake	0.0650	64.34
77	Leisure Lake	0.0650	64.34
78	St. Mary's Lake	0.0670	64.78
79	Little Bear Lake	0.0680	65.00
80	Buffalo Creek Reservoir 1	0.0680	65.00
81	Mary Lee Lake	0.0680	65.00
82	Wooster Lake	0.0700	65.41
83	Crooked Lake	0.0710	66.00
84	Timber Lake (South)	0.0720	65.82
85	Lake Helen	0.0720	65.82
86	Grandwood Park Lake	0.0720	65.82
87	ADID 203	0.0730	66.02
88	Bluff Lake	0.0730	66.02
89	Long Lake	0.0730	66.02
90	Spring Lake	0.0730	66.02
91	Broberg Marsh	0.0780	66.97
92	Woodland Lake	0.0800	68.00
93	Redwing Slough	0.0822	67.73
94	Tower Lake	0.0830	67.87
95	Petite Lake	0.0830	67.87
96	Lake Marie	0.0850	68.21
97	Potomac Lake	0.0850	68.21
98	White Lake	0.0862	68.42
99	Grand Ave Marsh	0.0870	68.55
100	North Churchill Lake	0.0870	68.55
101	McDonald Lake 1	0.0880	68.71
102	Lake Fairview	0.0890	68.00
103	Rivershire Pond 2	0.0900	69.04
104	South Churchill Lake	0.0900	69.04

Table 5. Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
105	McGreal Lake	0.0910	69.20
106	Lake Charles	0.0930	69.40
107	Deer Lake	0.0940	69.66
108	Dunn's Lake	0.0950	69.82
109	Eagle Lake (S1)	0.0950	69.82
110	International Mine and Chemical Lake	0.0950	69.82
111	Valley Lake	0.0950	69.82
112	Big Bear Lake	0.0960	69.97
113	Buffalo Creek Reservoir 2	0.0960	69.97
114	Fish Lake	0.0960	69.97
115	Lochanora Lake	0.0960	69.97
116	Nippersink Lake	0.1000	70.56
117	Sylvan Lake	0.1000	70.56
118	Longview Meadow Lake	0.1020	70.84
119	Lake Forest Pond	0.1070	71.53
120	Bittersweet Golf Course #13	0.1100	71.93
121	Fox Lake	0.1100	71.93
122	Kemper 2	0.1100	71.93
123	Middlefork Savannah Outlet 1	0.1120	72.00
124	Osprey Lake	0.1110	72.06
125	Bresen Lake	0.1130	72.32
126	Round Lake Marsh North	0.1130	72.32
127	Deer Lake Meadow Lake	0.1160	72.70
128	Taylor Lake	0.1180	72.94
129	Island Lake	0.1210	73.00
130	Columbus Park Lake	0.1230	73.54
131	Lake Nipperink	0.1240	73.66
132	Echo Lake	0.1250	73.77
133	Grass Lake	0.1290	74.23
134	Lake Holloway	0.1320	74.56
135	Redhead Lake	0.1410	75.51
136	Antioch Lake	0.1450	75.91
137	Slocum Lake	0.1500	77.00
138	Lakewood Marsh	0.1510	76.50
139	Pond-A-Rudy	0.1510	76.50
140	Lake Matthews	0.1520	76.59
141	Forest Lake	0.1540	76.78
142	Middlefork Savannah Outlet 2	0.1590	77.00
143	Pistakee Lake	0.1590	77.24
144	Grassy Lake	0.1610	77.42
145	Salem Lake	0.1650	77.78
146	Half Day Pit	0.1690	78.12
147	Lake Eleanor	0.1810	79.11
148	Lake Farmington	0.1850	79.43
149	Lake Louise	0.1850	79.43
150	ADID 127	0.1890	79.74
151	Lake Napa Suwe	0.1940	80.00
152	Patski Pond	0.1970	80.33
153	Dog Bone Lake	0.1990	80.48
154	Summerhill Estates Lake	0.1990	80.48
155	Redwing Marsh	0.2070	81.05
156	Stockholm Lake	0.2082	81.13

Table 5. Lake County average TSI phosphorus (TSIp) ranking 2000-2013.

RANK	LAKE NAME	TP AVE	TSIp
157	Bishop Lake	0.2160	81.66
158	Ozaukee Lake	0.2200	81.93
159	Kemper 1	0.2220	82.08
160	Hidden Lake	0.2240	82.19
161	McDonald Lake 2	0.2250	82.28
162	Fischer Lake	0.2280	82.44
163	Oak Hills Lake	0.2790	85.35
164	Loch Lomond	0.2950	86.16
165	Heron Pond	0.2990	86.35
166	Rollins Savannah 1	0.3070	87.00
167	Fairfield Marsh	0.3260	87.60
168	ADID 182	0.3280	87.69
169	Manning's Slough	0.3820	90.22
170	Slough Lake	0.3860	90.03
171	Rasmussen Lake	0.4860	93.36
172	Albert Lake, Site II, outflow	0.4950	93.67
173	Flint Lake Outlet	0.5000	93.76
174	Rollins Savannah 2	0.5870	96.00
175	Almond Marsh	1.9510	113.00

Table 6. Multiparameter data for Tower Lake, 2013.

Tower Lake 2013 Multiparameter data

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											1.495
5/21/2013	0.25	0.41	24.04	8.49	101.9	0.7602	8.17	4006	Surface		
5/21/2013	1	1.05	24.07	8.88	106.7	0.7597	8.19	3921	Surface	100%	
5/21/2013	2	2.05	24.04	8.87	106.5	0.7597	8.20	135	0.38	3%	8.87
5/21/2013	3	3.03	23.99	8.85	106.2	0.7601	8.20	143	1.36	4%	-0.04
5/21/2013	4	4.07	23.91	8.50	101.8	0.7596	8.18	139	2.4	4%	0.01
5/21/2013	5	5.04	23.62	7.82	93.2	0.7595	8.10	100	3.37	3%	0.10
5/21/2013	6	6.61	18.12	4.76	50.9	0.7471	7.59	98	4.94	2%	0.00
5/21/2013	7	7.30	15.66	2.67	27.1	0.7584	7.43	82	5.63	2%	0.03

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.821
6/18/2013	0.25	0.49	24.01	9.22	109.5	0.9193	8.13	1425	Surface		
6/18/2013	1	1.10	24.08	9.90	117.8	0.9198	8.24	1064	Surface	100%	
6/18/2013	2	2.01	24.10	9.88	117.6	0.9198	8.27	337	0.34	32%	3.38
6/18/2013	3	3.00	24.11	9.88	117.7	0.9196	8.27	213	1.33	20%	0.34
6/18/2013	4	4.18	24.11	9.88	117.7	0.9195	8.27	125	2.51	12%	0.21
6/18/2013	5	5.20	24.10	9.88	117.6	0.9194	8.27	92	3.53	9%	0.09
6/18/2013	6	6.00	24.09	9.86	117.4	0.9198	8.26	67	4.33	6%	0.07
6/18/2013	7	6.99	23.59	10.79	127.3	0.9195	8.26	53	5.32	5%	0.04

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.993
7/16/2013	0.25	0.75	30.39	8.74	115.1	0.6689	8.14	4437	Surface		
7/16/2013	1	1.01	30.40	8.85	116.6	0.6687	8.13	4904	Surface	100%	
7/16/2013	2	2.02	29.88	8.92	116.4	0.6687	8.12	3936	0.35	370%	0.63
7/16/2013	3	3.08	29.36	8.60	111.3	0.6685	8.08	397	1.41	37%	1.63
7/16/2013	4	3.93	27.43	4.38	54.8	0.6775	7.44	765	2.26	72%	-0.29
7/16/2013	5	5.06	26.99	2.29	28.5	0.6788	7.32	414	3.39	39%	0.18
7/16/2013	6	6.06	25.63	0.72	8.7	0.6852	7.11	47	4.39	4%	0.50
7/16/2013	7	7.00	24.12	0.40	4.7	0.6832	7.00	93	5.33	9%	-0.13

Table 6. Multiparameter data for Tower Lake, 2013.

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											1.229
8/20/2013	0.25	0.75	24.27	10.69	129.9	0.6878	8.40	3132	Surface		
8/20/2013	1	1.00	24.30	11.33	135.2	0.6878	8.41	3120	Surface	100%	
8/20/2013	2	2.00	24.22	11.13	131.6	0.6889	8.38	773	0.33	73%	4.23
8/20/2013	3	3.00	24.07	9.62	114.5	0.6914	8.30	213	1.33	20%	0.97
8/20/2013	4	4.00	23.58	7.68	88.3	0.6932	8.08	175	2.33	16%	0.08
8/20/2013	5	5.00	22.91	3.44	38.1	0.6963	7.61	74	3.33	7%	0.26
8/20/2013	6	6.00	22.56	0.54	6.9	0.6985	7.42	36	4.33	3%	0.17
8/20/2013	7	7.00	22.33	0.35	3.9	0.7062	7.26	15	5.33	1%	0.16

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.908
	0.25	0.50	19.12	9.66	103.1	0.6694	8.26	2784	Surface		
9/17/2013	1	1.00	19.11	9.64	102.9	0.6686	8.28	2757	Surface	100%	
9/17/2013	2	2.00	19.06	9.62	102.4	0.6681	8.28	1006	0.33	95%	3.06
9/17/2013	3	3.00	18.97	9.56	100.5	0.6688	8.27	370	1.33	35%	0.75
9/17/2013	4	4.00	18.85	9.26	98.2	0.6693	8.25	50	2.33	5%	0.86
9/17/2013	5	5.00	18.67	9.30	98.4	0.6684	8.27	14	3.33	1%	0.38
9/17/2013	6	6.00	18.52	8.90	93.7	0.6687	8.24	6	4.33	1%	0.20
9/17/2013	7	7.00	18.27	8.51	89.1	0.6697	8.19	2	5.33	0%	0.21

Figure 5. 2013 TP concentrations measured in Tower Lake.

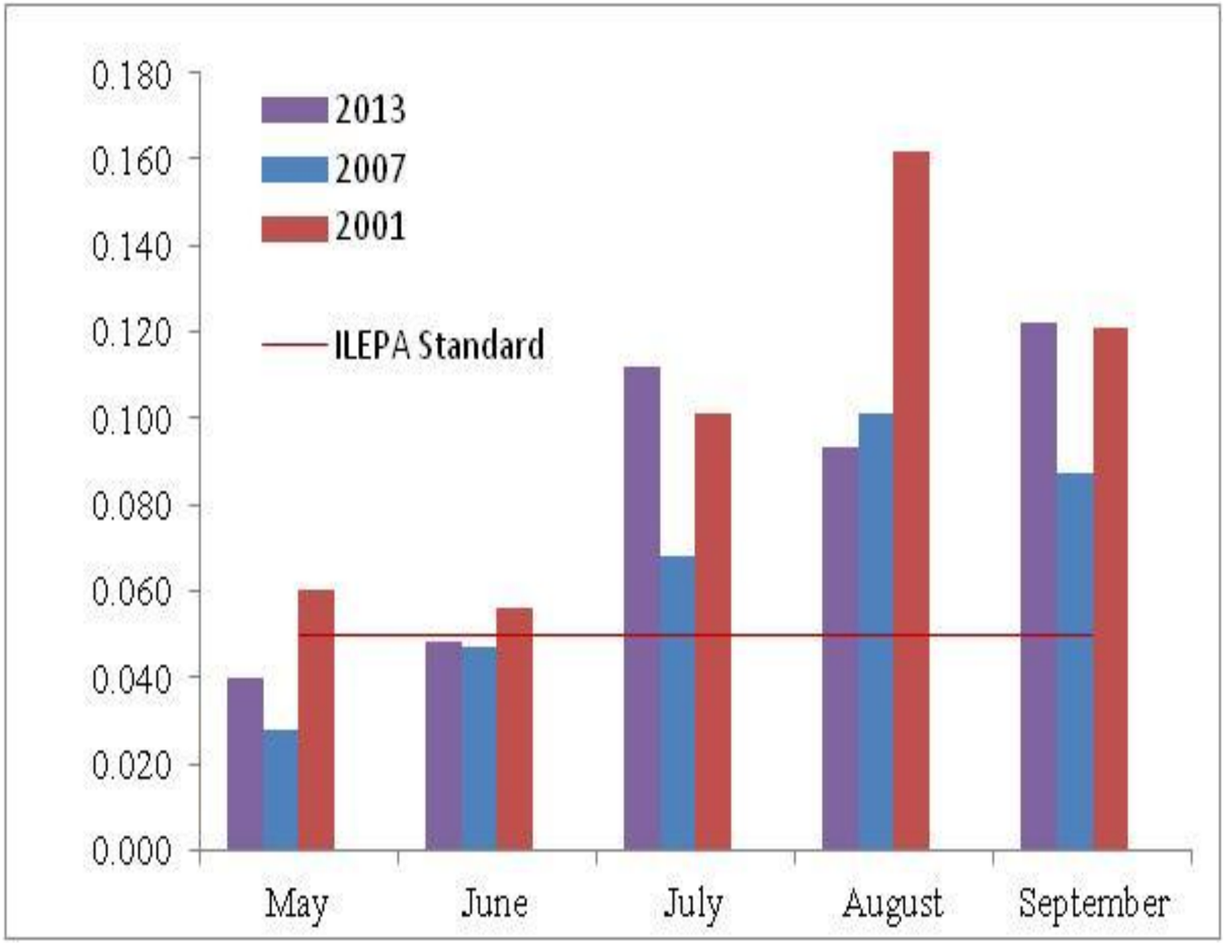


Table 7a. Aquatic plants found at the 71 sampling sites on Tower Lake in July 2013. The maximum depth that plants were found was 10.0 feet.

Plant Density	Bladderwort	Chara	Coontail	Small Pondweed	White water Lily
Absent	68	70	41	66	20
Present	3	0	12	3	11
Common	0	0	10	0	23
Abundant	0	1	4	2	14
Dominant	0	0	4	0	3
% Plant Occurrence	4.2	1.4	42.3	7.0	71.8

Table 7b. Distribution of rake density across all sampling sites.

Rake Density (coverage)	# of Sites	% of Sites
No Plants	17	24
>0-10%	9	13
10-40%	20	28
40-60%	17	24
60-90%	6	8
>90%	2	3
Total Sites with Plants	54	76
Total # of Sites	71	100

Figure 6. Estimated rake density of vegetation occurring in Tower Lake, 2013.

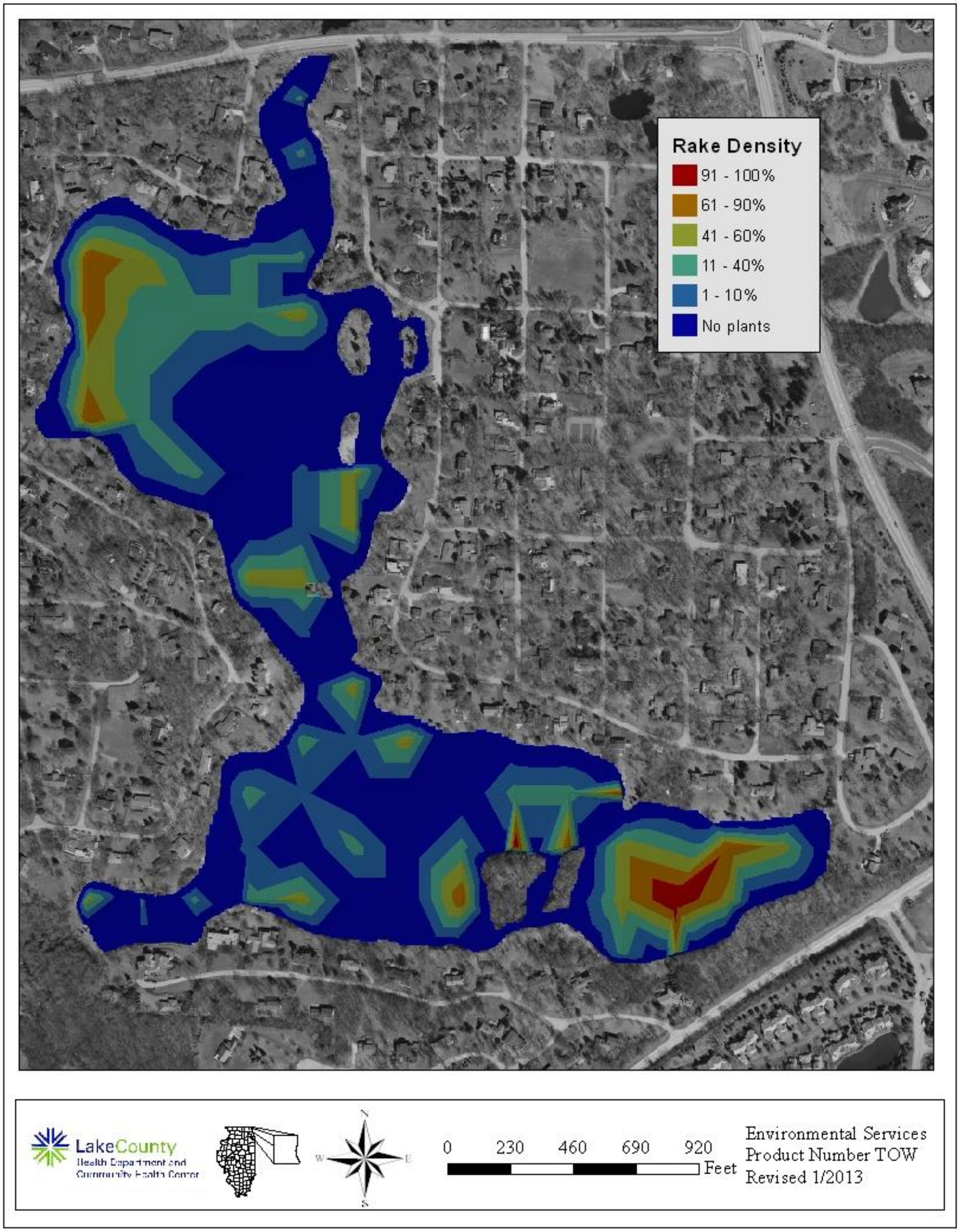


Table 8. Lake County average Floristic Quality Index ranking 2000 – 2013.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
1	Cedar Lake	38.0	36.6
2	East Loon Lake	34.7	36.1
3	Cranberry Lake	29.7	29.7
4	Deep Lake	29.7	31.2
5	Bangs Lake	29.6	26.0
6	Little Silver Lake	29.6	31.6
7	Round Lake Marsh North	29.1	29.9
8	West Loon Lake	27.1	29.5
9	Sullivan Lake	26.9	28.5
10	Third Lake	25.1	22.5
11	Fourth Lake	24.7	27.1
12	Indpendence Grove	24.6	27.5
13	Sterling Lake	24.5	26.9
14	Sun Lake	24.3	26.1
15	Lake Zurich	24.3	27.1
16	Redwing Slough	24.0	25.8
17	Schreiber Lake	23.9	24.8
18	Lakewood Marsh	23.8	24.7
19	Deer Lake	23.5	24.4
20	Round Lake	23.5	25.9
21	Honey Lake	23.3	25.1
22	Lake of the Hollow	23.0	24.8
23	Wooster Lake	22.8	21.1
24	Cross Lake	22.4	24.2
25	Countryside Glen Lake	21.9	22.8
26	Davis Lake	21.4	21.4
27	Butler Lake	21.4	23.1
28	Lake Barrington	21.2	21.2
29	Duck Lake	21.1	22.9
30	Timber Lake (North)	20.9	23.4
31	ADID 203	20.5	20.5
32	Broberg Marsh	20.5	21.4
33	McGreal Lake	20.2	22.1
34	Lake Kathryn	19.6	20.7
35	Fish Lake	19.3	21.2
36	Redhead Lake	19.3	21.2
37	Druce Lake	19.1	21.8
38	Turner Lake	18.6	21.2
39	Salem Lake	18.5	20.2
40	Lake Helen	18.0	18.0
41	Old Oak Lake	18.0	19.1
42	Potomac Lake	17.8	17.8
43	Long Lake	17.7	15.8
44	Hendrick Lake	17.7	17.7
45	Rollins Savannah 2	17.7	17.7
46	Grandwood Park Lake	17.2	19.0
47	Seven Acre Lake	17.0	15.5
48	Lake Miltmore	16.8	18.7
49	McDonald Lake 1	16.7	17.7
50	Highland Lake	16.7	18.9
51	Bresen Lake	16.6	17.8
52	Almond Marsh	16.3	17.3
53	Owens Lake	16.3	17.3
54	Windward Lake	16.3	17.6
55	Grays Lake	16.1	16.1
56	White Lake	16.0	17.0
57	Dog Bone Lake	15.7	15.7
58	Osprey Lake	15.5	17.3

Table 8. Lake County average Floristic Quality Index ranking 2000 – 2013.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
59	Heron Pond	15.1	15.1
60	North Churchill Lake	15.0	15.0
61	Hastings Lake	15.0	17.0
62	Lake Tranquility (S1)	15.0	17.0
63	Forest Lake	14.8	15.9
64	Dog Training Pond	14.7	15.9
65	Island Lake	14.7	16.6
66	Grand Ave Marsh	14.3	16.3
67	Nippersink Lake	14.3	16.3
68	Taylor Lake	14.3	16.3
69	Manning's Slough	14.1	16.3
70	Tower Lake	14.0	14.0
71	Dugdale Lake	14.0	15.1
72	Eagle Lake (S1)	14.0	15.1
73	Crooked Lake	14.0	16.0
74	Longview Meadow Lake	13.9	13.9
75	Bishop Lake	13.4	15.0
76	Ames Pit	13.4	15.5
77	Mary Lee Lake	13.1	15.1
78	Old School Lake	13.1	15.1
79	Dunn's Lake	12.7	13.9
80	Summerhill Estates Lake	12.7	13.9
81	Buffalo Creek Reservoir 1	12.5	11.4
82	Buffalo Creek Reservoir 2	12.5	11.4
83	McDonald Lake 2	12.5	12.5
84	Rollins Savannah 1	12.5	12.5
85	Stone Quarry Lake	12.5	12.5
86	Kemper Lake 1	12.2	13.4
87	Pond-A-Rudy	12.1	12.1
88	Stockholm Lake	12.1	13.5
89	Lake Carina	12.1	14.3
90	Lake Leo	12.1	14.3
91	Lambs Farm Lake	12.1	14.3
92	Grassy Lake	12.0	12.0
93	Lake Matthews	12.0	12.0
94	Flint Lake Oulet	11.8	13.0
95	Albert Lake	11.5	10.3
96	Rivershire Pond 2	11.5	13.3
97	Antioch Lake	11.3	13.4
98	Hook Lake	11.3	13.4
99	Briarcrest Pond	11.2	12.5
100	Lake Naomi	11.2	12.5
101	Pulaski Pond	11.2	12.5
102	Lake Napa Suwe	11.0	11.0
103	Redwing Marsh	11.0	11.0
104	West Meadow Lake	11.0	11.0
105	Lake Minear	11.0	13.9
106	Nielsen Pond	10.7	12.0
107	Lake Holloway	10.6	10.6
108	Sylvan Lake	10.6	10.6
109	Crooked Lake	10.2	12.5
110	Gages Lake	10.2	12.5
111	College Trail Lake	10.0	10.0
112	Valley Lake	9.9	9.9
113	Werhane Lake	9.8	12.0
114	Loch Lomond	9.4	12.1
115	Columbus Park Lake	9.2	9.2
116	Lake Lakeland Estates	9.2	9.2
117	Waterford Lake	9.2	9.2
118	Lake Fairfield	9.0	10.4
119	Lake Louise	9.0	10.4

Table 8. Lake County average Floristic Quality Index ranking 2000 – 2013.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
120	Fischer Lake	9.0	11.0
121	Lake Fairview	8.5	6.9
122	Timber Lake (South)	8.5	6.9
123	East Meadow Lake	8.5	8.5
124	South Churchill Lake	8.5	8.5
125	Kemper Lake 2	8.5	9.8
126	Lake Christa	8.5	9.8
127	Lake Farmington	8.5	9.8
128	Lucy Lake	8.5	9.8
129	Bittersweet Golf Course #13	8.1	8.1
130	Lake Linden	8.0	8.0
131	Sand Lake	8.0	10.4
132	Countryside Lake	7.7	11.5
133	Fairfield Marsh	7.5	8.7
134	Lake Eleanor	7.5	8.7
135	Banana Pond	7.5	9.2
136	Slocum Lake	7.1	5.8
137	Lucky Lake	7.0	7.0
138	North Tower Lake	7.0	7.0
139	Lake Forest Pond	6.9	8.5
140	Ozaukee Lake	6.7	8.7
141	Leisure Lake	6.4	9.0
142	Peterson Pond	6.0	8.5
143	Little Bear Lake	5.8	7.5
144	Deer Lake Meadow Lake	5.2	6.4
145	ADID 127	5.0	5.0
146	Island Lake	5.0	5.0
147	Liberty Lake	5.0	5.0
148	Oak Hills Lake	5.0	5.0
149	Slough Lake	5.0	5.0
150	International Mining and Chemical Lake	5.0	7.1
151	Diamond Lake	3.7	5.5
152	Lake Charles	3.7	5.5
153	Big Bear Lake	3.5	5.0
154	Sand Pond (IDNR)	3.5	5.0
155	Harvey Lake	3.3	5.0
156	Half Day Pit	2.9	5.0
157	Lochanora Lake	2.5	5.0
158	Echo Lake	0.0	0.0
159	Hidden Lake	0.0	0.0
160	St. Mary's Lake	0.0	0.0
161	Willow Lake	0.0	0.0
162	Woodland Lake	0.0	0.0

Figure 7. Shoreline erosion assessed on Tower Lake, 2013.

Figure 8. VLMP monitoring sites – Tower Lake